Final

Site Investigation Report
Sinkholes at Pelham Range

Fort McClellan
Calhoun County, Alabama

Prepared for:

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Task Order CK05
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Executive Summary

In accordance with Contract Number DACA21-96-D-0018, Task Order CK05, Shaw Environmental, Inc. completed a site investigation (SI) at the Sinkholes at Pelham Range at Fort McClellan (FTMC) in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site as a result of historical mission-related Army activities. The SI consisted of geophysical surveys, a field radiological survey, and the collection and analysis of 7 surface soil samples and 11 subsurface soil samples. This investigation was performed to fulfill the requirements of a Memorandum of Agreement (MOA) between the Alabama Army National Guard (ALARNG) and the U.S. Army with regard to the transfer of Pelham Range to the ALARNG. Although a U.S. Army Center for Health Promotion and Preventive Medicine preliminary assessment identified these areas as "sinkholes," subsequent site reconnaissance revealed that one, possibly two, of the sites may be surface depressions or topographical low areas – not actual sinkholes.

Geophysical surveys were conducted at three of the four locations (Area 8C, Area 22C, and Area 24C) to identify possible buried metal debris indicative of subsurface disposal. A geophysical survey was not performed at Area 2D because no sinkhole was found. However, a topographic low area was surveyed using a hand-held metal detector. The geophysical survey results did not indicate the presence of large buried metal objects such as drums or smoke pots at any of the sites. In addition, a field radiological survey was conducted at the Area 24C depression. All readings were below background levels.

Chemical analysis of samples collected at the sites indicates that metals, volatile organic compounds (VOC), pesticides, explosive compounds, and one herbicide were detected in the environmental media sampled. Semivolatile organic compounds and polychlorinated biphenyls were not detected in any of the samples. To evaluate whether the detected constituents pose an unacceptable risk to human health or the environment, the analytical results were compared to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. Site metals data were further evaluated using statistical and geochemical methods to select site-related metals.

Although Pelham Range is projected for continued military training reuse by the ALARNG, residential SSSLs were used to screen these sites for risk assessment purposes. Constituents detected at concentrations exceeding SSSLs and background (where available) were identified as chemicals of potential concern (COPC) in site media. Surface soil COPCs were limited to

aluminum at Areas 22C and 2D. Subsurface soil COPCs were aluminum and arsenic at Areas 8C and 2D and vanadium at Area 2D. However, the statistical and geochemical evaluation determined that these metals are present at naturally occurring levels. Therefore, these metals are not expected to pose a threat to human health. VOC, pesticide, herbicide, and explosive compound concentrations were all below SSSLs.

Constituents detected at concentrations exceeding ESVs and background (where available) were identified as constituents of potential ecological concern (COPEC) in surface soil and included metals, pesticides, and explosives. The metals identified as COPECs were as follows: mercury and selenium (Area 8C); aluminum, barium, mercury, and zinc (Area 22C); lead (Area 24C); and aluminum and zinc (Area 2D). However, these metals were judged to be present at naturally occurring levels. The pesticides identified as COPECs are as follows: 4,4'-DDT, beta-BHC, endrin, and gamma-BHC (Area 8C); alpha-BHC, beta-BHC, and endrin (Area 22C); and 4,4'-DDT and gamma-BHC (Area 24C). In addition, two explosive compounds (2,6-dinitrotoluene and 1,3,5-trinitrobenzene) were identified as COPECs at Area 8C. In most instances, the concentrations of these compounds were estimated and only marginally exceeded their respective ESVs. The ESVs are highly conservative values, based on either no-observed-adverse-effects levels or the most health-protective values available, and are intended to be protective of the most sensitive individual organism. Therefore, risks to potential ecological receptors are likely overestimated. Based on these considerations, further investigation of the low levels of these contaminants is not warranted.

Based on the results of the SI, past operations at the Sinkholes at Pelham Range have not adversely impacted the environment. The metals and chemical compounds detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, Shaw Environmental, Inc. recommends "No Further Action" and unrestricted land reuse with regard to CERCLA-related hazardous substances at the Sinkholes at Pelham Range.

1.0 Introduction

The U.S. Army has selected Fort McClellan (FTMC) located in Calhoun County, Alabama, for closure by the Base Realignment and Closure (BRAC) Commission under Public Laws 100-526 and 101-510. The 1990 Base Closure Act, Public Law 101-510, established the process by which U.S. Department of Defense (DOD) installations would be closed or realigned. The BRAC Environmental Restoration Program requires investigation and cleanup of federal properties prior to transfer to the public domain. The U.S. Army is conducting environmental studies of the impact of suspected contaminants at parcels at FTMC under the management of the U.S. Army Corps of Engineers (USACE), Mobile District. The USACE contracted Shaw Environmental, Inc. (Shaw) (formerly IT Corporation [IT]) to perform the site investigation (SI) of the Sinkholes at Pelham Range, under Contract Number DACA21-96-D-0018, Task Order CK05.

This report presents specific information and results compiled from the SI, including geophysical surveys, a field radiological survey, and field sampling and analysis conducted at the Sinkholes at Pelham Range.

1.1 Project Description

The Sinkholes at Pelham Range were identified in the *Draft Preliminary Assessment No. 38-EH-1775-99, Fort McClellan Army National Guard Training Center, Fort McClellan, Alabama* (U.S. Army Center for Health Promotion and Preventive Medicine [CHPPM], 1999) as areas to be investigated prior to property transfer. These areas were added to the Memorandum of Agreement (MOA) between the Alabama Army National Guard (ALARNG) and the U.S. Army relative to the transfer of Pelham Range to the ALARNG. The CHPPM report recommended a geophysical survey of the sinkholes to determine if metallic debris is present (CHPPM, 1999). In May 2001, the FTMC BRAC Cleanup Team (BCT) requested that soil samples be collected at each of the sinkholes and that a field radiological survey be conducted at the Area 24C sinkhole. Although the CHPPM report identifies these areas as "sinkholes," subsequent site reconnaissance revealed that one, possibly two, of the holes are merely surface depressions or topographical low areas.

The field activities were conducted according to the installation-wide work plan (IT, 1998) and the installation-wide sampling and analysis plan (SAP) (IT, 2000a; IT, 2002). The SAP includes the installation-wide safety and health plan and quality assurance plan.

The SI included fieldwork to collect 7 surface soil samples and 11 subsurface soil samples to determine whether potential site-specific chemicals are present at the sites. In addition, geophysical surveys were conducted at three of the sites (Areas 8C, 22C, and 24C) to identify potential buried metallic debris (e.g., drums) and a field radiological survey was performed at Area 24C.

1.2 Purpose and Objectives

The SI program was designed to collect data from site media and provide a level of defensible data and information in sufficient detail to determine whether chemical constituents are present at the Sinkholes at Pelham Range at concentrations that pose an unacceptable risk to human health or the environment. The conclusions of the SI in Chapter 6.0 are based on the comparison of the analytical results to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. The SSSLs and ESVs were developed as part of the human health and ecological risk evaluations associated with SIs being performed under the BRAC Environmental Restoration Program at FTMC. The SSSLs and ESVs are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000b). Background metals screening values are presented in the *Final Background Metals Survey Report, Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Based on the conclusions presented in this SI report, the BCT will decide either to propose "No Further Action" at the site or to conduct additional work at the sites.

1.3 Site Description and History

Potential sinkholes were identified within four separate training areas at Pelham Range: Area 8C in the southwestern portion of Pelham Range, Area 22C in the southeastern portion, Area 24C in the northwestern portion, and Area 2D in the northeastern portion (Figure 1-1). These sites are located in undeveloped areas of Pelham Range. Site reconnaissance by Alabama Department of Environmental Management (ADEM), U.S. Environmental Protection Agency (EPA), ALARNG, and Shaw personnel in November 2001 revealed that one, possibly two, of the sinkholes are actually topographically low areas that do not appear to be open crevices or holes. The low areas located at Areas 8C and 22C are characteristic of sinkholes. The location at Area 24C is a topographical low area or surface depression and is not believed to be a sinkhole. In addition, the location at Area 2D appears to be a surface depression that may have undergone some minor excavation in the past.

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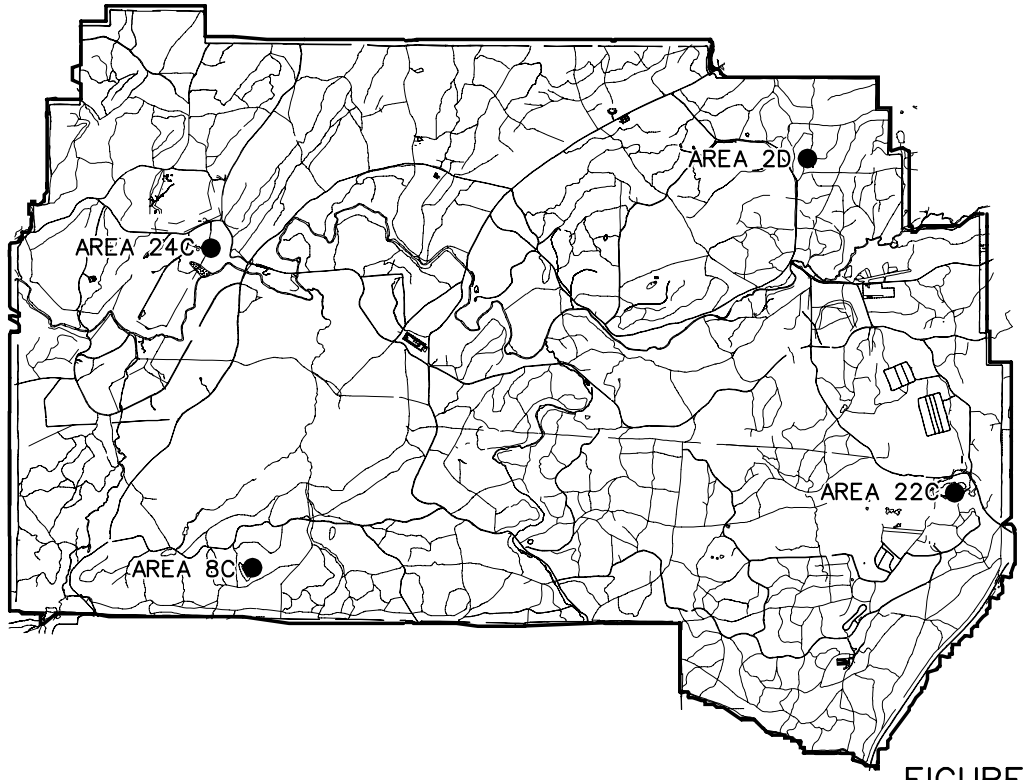

LEGEND

● SINKHOLE/SURFACE DEPRESSION

FIGURE 1-1
LOCATION OF SINKHOLES AT PELHAM RANGE

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

SCALE
0 8000 16000 FEET

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Surface water was not noted in any of the low areas. These sites were reportedly used during the 1960s as disposal areas for smoke pots, leaking fog oil drums, and supertropical bleach (STB) drums. Containers were often crushed by running over them with a truck prior to disposal (CHPPM, 1999). The approximate dimensions of the surface depressions are as follows: 720 by 560 feet (Area 8C); 160 by 160 feet (Area 22C); 120 by 60 feet (Area 24C); and 30 by 60 feet (Area 2D).

2.0 Previous Investigations

No previous investigations have been conducted to document environmental conditions at the Sinkholes at Pelham Range.

3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by Shaw at the Sinkholes at Pelham Range, including unexploded ordnance (UXO) avoidance activities, geophysical surveys, radiological survey, and environmental sampling and analysis.

3.1 UXO Avoidance

UXO avoidance was performed following methodology outlined in the SAP. Shaw UXO personnel used a low-sensitivity magnetometer to perform a surface sweep of the depressions prior to site access. After the sites were cleared for access, sample locations were monitored following procedures outlined in the SAP.

3.2 Geophysical Surveys

Geophysical surveys were conducted to locate buried metal debris at three of the surface depression locations (Areas 8C, 22C, and 24C). The geophysical survey at Area 8C encompassed an area of approximately 59,200 square feet (1.36 acres). The depth to the bottom of the sinkhole ranged from approximately 2 to 12 feet below ground surface (bgs) in the geophysical survey area. The geophysical survey at Area 22C encompassed approximately 49,600 square feet (1.14 acres). The depth to the bottom of the sinkhole ranged from approximately 2 to 9 feet bgs in the survey area. The geophysical survey at Area 24C encompassed approximately 13,500 square feet (0.31 acres). The depth to the bottom of the surface depression ranged from approximately 1 to 10 feet bgs with the identified drainage channel averaging about 6 feet bgs. A geophysical survey was not performed at Area 2D because no sinkhole was found within this area. However, during UXO avoidance activities, a topographic low area was measured at Area 2D using a hand-held magnetometer. The geophysical survey areas are shown on figures presented in Appendix A. A detailed discussion of the geophysical investigation, including theory of instrument operation, field procedures, data processing, and interpreted results of the investigation, is presented in Appendix A.

The surveys were conducted using magnetic and electromagnetic (EM) techniques. Initial survey grids were established at the sites to include the suspected sinkholes. Detailed, hand-sketched site maps were constructed based on field observations. The maps included any surface features within the surveyed areas, or near their perimeters, that could potentially affect the geophysical data (e.g., mounds, depressions, and fences). Preliminary color contour maps of the data were analyzed and compared with the site sketches to differentiate between anomalies caused by surface and subsurface source materials.

The geophysical survey results indicated no geophysical anomalies potentially representing areas containing buried metal debris at the Sinkholes at Pelham Range. The anomalies observed in the magnetic data were caused either by surface features (e.g., wire fence) or by local geological conditions. Geophysical interpretation maps (Appendix A) show the anomalous locations and contain detailed information on permanent site reference features to aid in relocating the anomalies and survey area. The anomalies shown correspond to those shown in the magnetic and EM data contour maps presented in the geophysical survey reports (Appendix A).

3.3 Radiological Survey

A field radiological survey was conducted at the Area 24C depression to determine if radiological anomalies were present at this site. This area was surveyed because of its proximity to the Burial Mound at Rideout Field, a known radioactive waste disposal area. The field survey consisted of surveying the sample location and adjacent area using a Ludlum Model 3 radiation survey meter. All readings were below background levels.

3.4 Environmental Sampling

The environmental sampling performed during the SI at the Sinkholes at Pelham Range included the collection of surface and subsurface soil samples for chemical analysis. The sample locations, media, and rationale are summarized in Table 3-1. Sampling locations are shown on Figures 3-1 through 3-4. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.6.

3.4.1 Surface Soil Sampling

A total of seven surface soil samples were collected at the Sinkholes at Pelham Range, including four samples in Area 8C and one sample each in Areas 22C, 24C, and 2D (Figures 3-1 through 3-4). Soil sampling locations and rationale are presented in Table 3-1. Soil sample designations and analytical parameters are listed in Table 3-2.

Sample Collection. Surface soil samples were collected from the uppermost foot of soil with a stainless-steel hand auger, following methodology specified the SAP. The samples were collected by first removing surface debris (e.g., rocks and vegetation) from the immediate sample area. The soil was then collected with the sampling device and screened with a photoionization detector (PID) in accordance with procedures described in the SAP. The soil fraction for volatile organic compound (VOC) analysis was collected directly from the sampler using three EnCore® samplers. The remaining sample was then transferred to a clean stainless-steel bowl,

Table 3-1

Sampling Locations and Rationale
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Media	Sample Location Rationale
PR-8C-SB01	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected in the eastern portion of the sinkhole in Training Area 8C to determine if potential site-specific chemicals have impacted the site.
PR-8C-SB02	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected in the central portion of the sinkhole in Training Area 8C to determine if potential site-specific chemicals have impacted the site.
PR-8C-SB03	Surface Soil	A surface soil sample was collected in the central portion of the sinkhole in Training Area 8C to determine if potential site-specific chemicals have impacted the site.
PR-8C-SB04	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected along the western edge of the sinkhole in Training Area 8C to determine if potential site-specific chemicals have impacted the site.
PR-22C-SB01	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected in the sinkhole in Training Area 22C to determine if potential site-specific chemicals have impacted the site.
PR-24C-SB01	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected in the depression in Training Area 24C to determine if potential site-specific chemicals have impacted the site.
PR-2D-SB01	Surface Soil Subsurface Soil	Surface and subsurface soil samples were collected in the depression in Training Area 2D to determine if potential site-specific chemicals have impacted the site.

Table 3-2

Soil Sample Designations and Analytical Parameters
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location	Sample Designation	Sample Depth (ft)	Analytical Parameters
PR-8C-SB01	PR-8C-SB01-SS-XQ0001-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-8C-SB01-DS-XQ0002-REG	2 - 4	
	PR-8C-SB01-DS-XQ0003-REG	7 - 8	
PR-8C-SB02	PR-8C-SB02-SS-XQ0004-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-8C-SB02-DS-XQ0005-REG	2 - 4	
	PR-8C-SB02-DS-XQ0006-REG	6 - 6.5	
PR-8C-SB03	PR-8C-SB03-SS-XQ0007-REG	0 - 0.5	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
PR-8C-SB04	PR-8C-SB04-SS-XQ0010-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-8C-SB04-DS-XQ0011-REG	2 - 2.5	
	PR-8C-SB04-DS-XQ0012-REG	2.5 - 3	
PR-22C-SB01	PR-22C-SB01-SS-XQ0013-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-22C-SB01-DS-XQ0014-REG	2 - 4	
	PR-22C-SB01-DS-XQ0015-REG	7 - 8	
PR-24C-SB01	PR-24C-SB01-SS-XQ0021-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-24C-SB01-DS-XQ0022-REG	3 - 4	
PR-2D-SB01	PR-2D-SB01-SS-XQ0017-REG	0 - 1	Metals, VOCs, SVOCs, Pesticides, Herbicides, Explosives, and PCBs
	PR-2D-SB01-DS-XQ0018-REG	4 - 5	
	PR-2D-SB01-DS-XQ0019-REG	7 - 8	

REG - Regular field sample.
VOC - Volatile organic compound.
SVOC - Semivolatile organic compound.
PCB - Polychlorinated biphenyl.

LEGEND

- UNIMPROVED ROAD
- TOPOGRAPHIC CONTOUR (CONTOUR INTERVAL - 5 FOOT)
- GEOPHYSICAL SURVEY AREA
- DEPRESSION
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION
- SURFACE SOIL SAMPLE LOCATION

NOTE:

1. TWO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT THIS LOCATION.

SCALE
0 80 160 FEET

FIGURE 3-1
SAMPLE LOCATION MAP
TRAINING AREA 8C
PELHAM RANGE

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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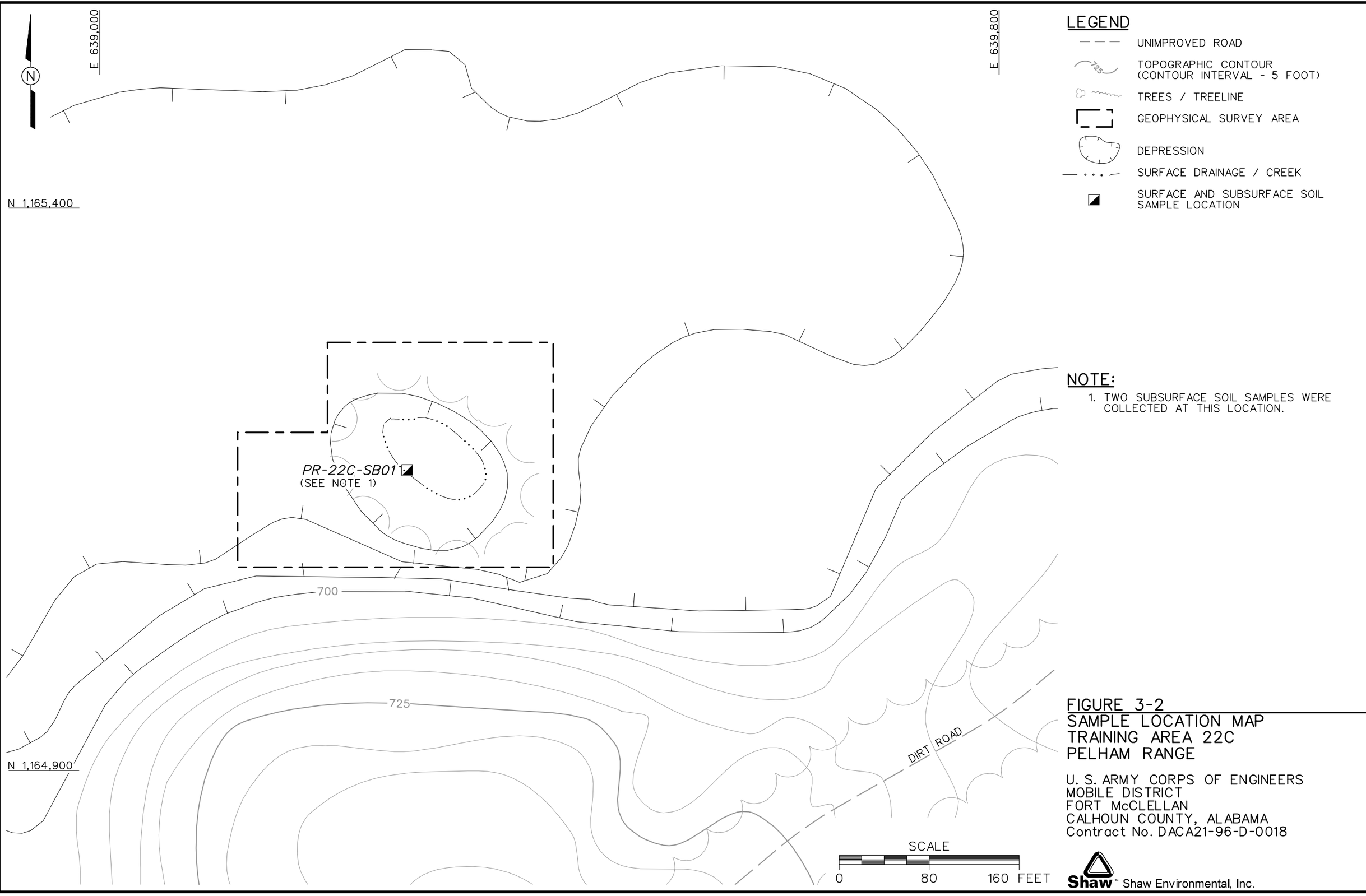

LEGEND

- UNIMPROVED ROAD
- TOPOGRAPHIC CONTOUR (CONTOUR INTERVAL - 5 FOOT)
- TREES / TREELINE
- GEOPHYSICAL SURVEY AREA
- DEPRESSION
- SURFACE DRAINAGE / CREEK
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION

NOTE:

1. TWO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT THIS LOCATION.

FIGURE 3-2
SAMPLE LOCATION MAP
TRAINING AREA 22C
PELHAM RANGE

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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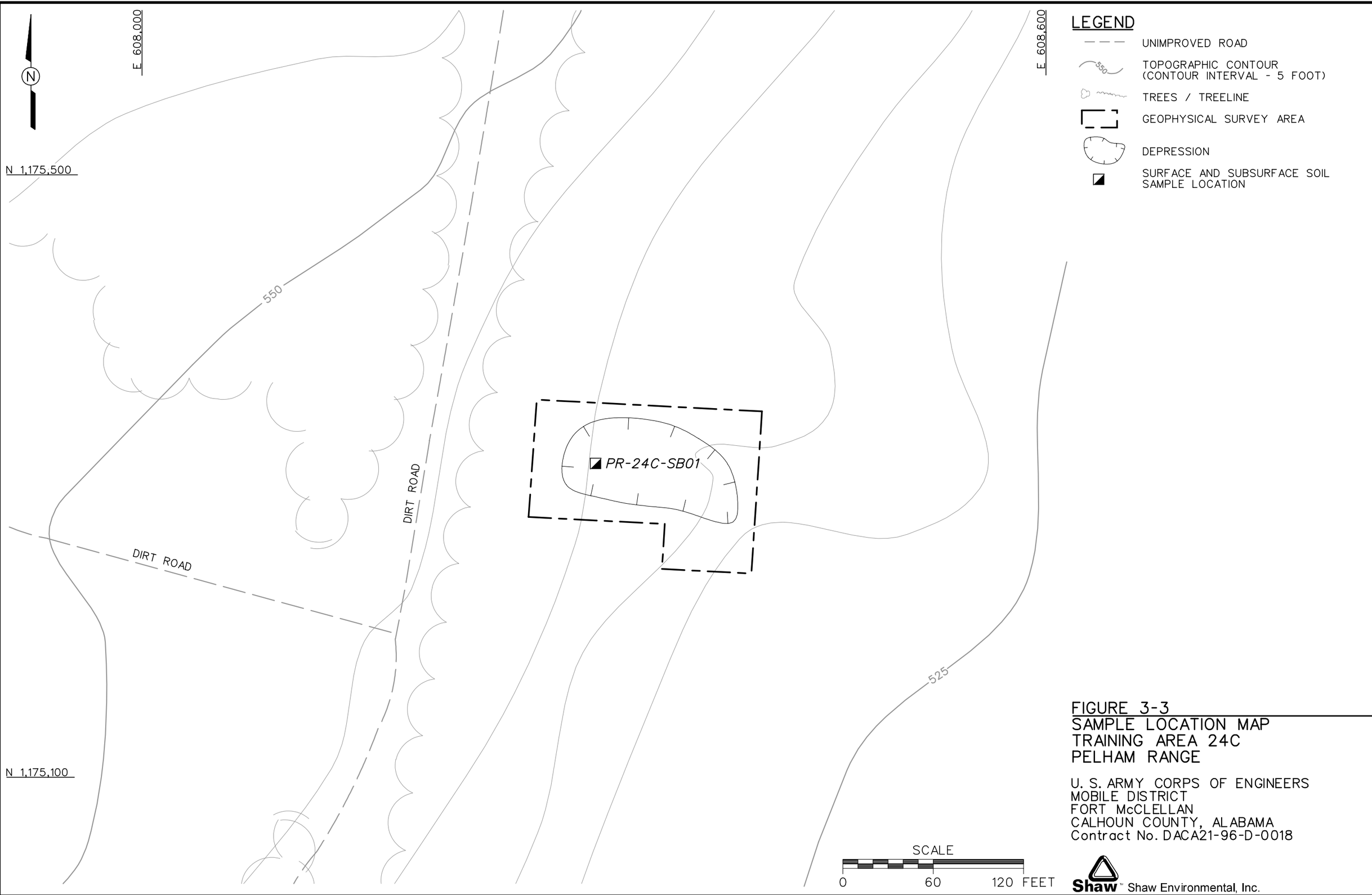

FIGURE 3-3
SAMPLE LOCATION MAP
TRAINING AREA 24C
PELHAM RANGE

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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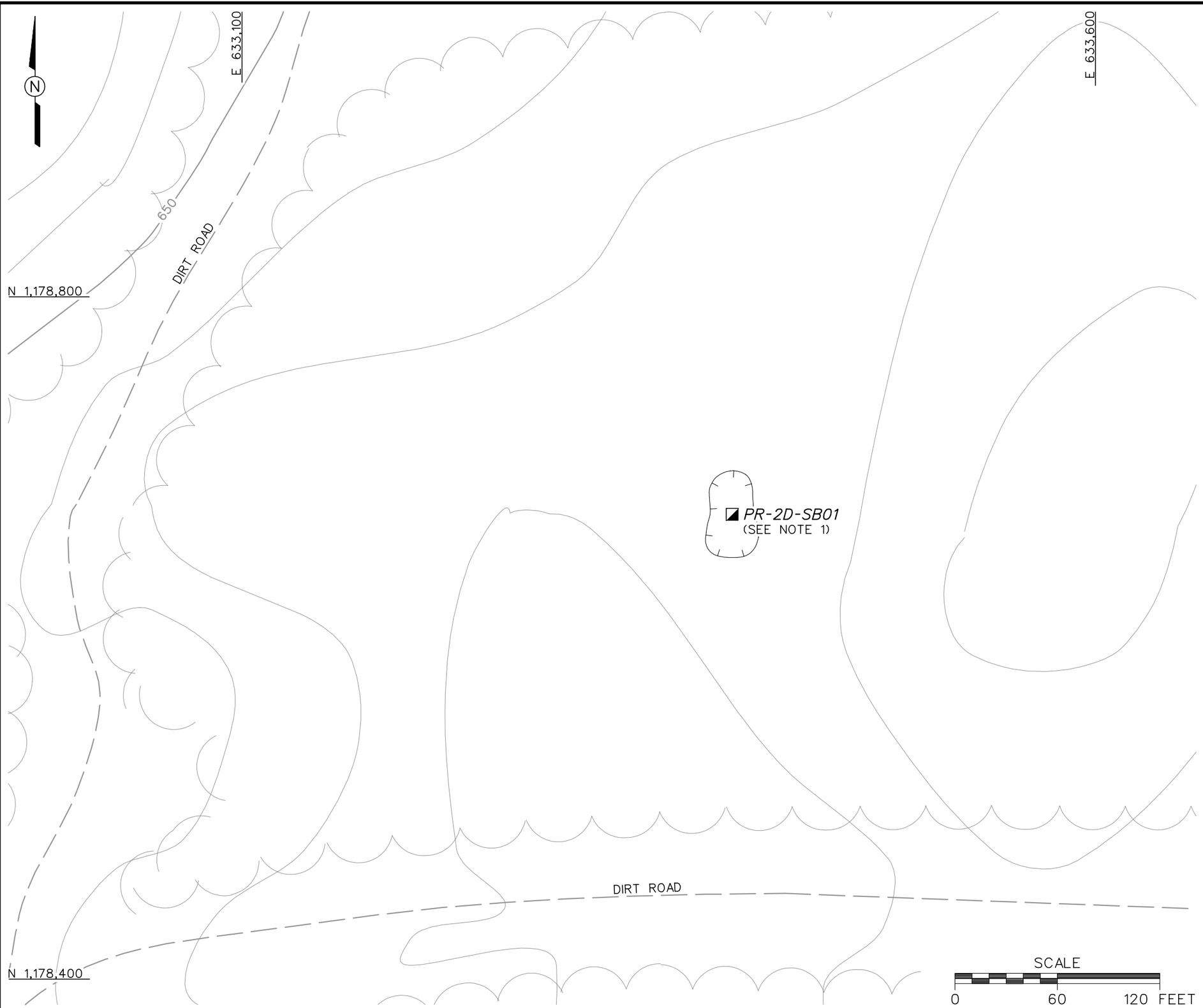

LEGEND

- UNIMPROVED ROAD
- TOPOGRAPHIC CONTOUR (CONTOUR INTERVAL - 5 FOOT)
- TREES / TREELINE
- DEPRESSION
- SURFACE AND SUBSURFACE SOIL SAMPLE LOCATION

NOTE:

1. TWO SUBSURFACE SOIL SAMPLES WERE COLLECTED AT THIS LOCATION.

FIGURE 3-4
SAMPLE LOCATION MAP
TRAINING AREA 2D
PELHAM RANGE

U. S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT
FORT McCLELLAN
CALHOUN COUNTY, ALABAMA
Contract No. DACA21-96-D-0018

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homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix B. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.6.

3.4.2 Subsurface Soil Sampling

A total of 11 subsurface soil samples were collected from 6 soil borings at the Sinkholes at Pelham Range, as shown on Figures 3-1 through 3-4. At Area 8C, two subsurface soil samples were collected from each of three borings. At Areas 22C and 2D, two subsurface soil samples were collected from one boring at each sinkhole. At Area 24C, one subsurface soil sample was collected from one boring. Subsurface soil sampling locations and rationale are presented in Table 3-1. Subsurface soil sample designations, depths, and analytical parameters are listed in Table 3-2.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than one foot bgs in the unsaturated zone. The soil borings were advanced and samples collected using a stainless-steel hand auger, following procedures specified in the SAP. Sample collection logs are included in Appendix B. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.6.

The soil borings were advanced to the depth of hand auger refusal. Samples were collected at depths ranging from 2 to 8 feet bgs. Samples were field screened using a PID to measure volatile organic vapors. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were below background, the deepest sample interval was submitted for analysis. The soil fraction for VOC analysis was collected directly from the sampler using three EnCore samplers. The remaining sample was then transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring. The soil boring logs are included in Appendix C.

3.5 Surveying of Sample Locations

Sample locations were surveyed using global positioning system survey techniques and conventional civil survey techniques described in the SAP. Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983. Elevations were referenced to the North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.6 Analytical Program

Samples collected during the SI were analyzed for various chemical parameters based on potential site-specific chemicals and on EPA, ADEM, FTMC, and USACE requirements. Samples collected at the Sinkholes at Pelham Range were analyzed for the following parameters using EPA analytical methods:

- Target analyte list metals – EPA Method 6010B/7471A
- Target compound list (TCL) VOCs – EPA Method 8260B
- TCL semivolatile organic compounds (SVOC) – EPA Method 8270C
- Nitroaromatic and nitramine explosives – EPA Method 8330
- Chlorinated pesticides - EPA Method 8081A
- Organophosphorus pesticides - EPA Method 8141/8141A
- Chlorinated herbicides - EPA Method 8151A
- Polychlorinated biphenyls (PCB) - EPA Method 8082.

3.7 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging, and shipping followed requirements specified in the SAP. Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SI are listed in the SAP. Sample documentation and chain-of-custody records were completed as specified in the SAP.

Completed analysis request and chain-of-custody records (Appendix B) were included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.8 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in the SAP. The IDW generated during the SI at the Sinkholes at Pelham Range was segregated as follows:

- Soil boring cuttings
- Decontamination fluids
- Personal protective equipment (PPE).

Solid IDW was stored on site in lined roll-off bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analysis. Based on the results of the analyses, soil boring cuttings and PPE generated during the SI were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was contained in a portable tank at the site pending waste characterization by VOC, SVOC, and metals analyses. Based on the analyses, liquid IDW was discharged as nonregulated waste to the FTMC wastewater treatment plant on the Main Post.

3.9 Variances/Nonconformances

No variances or nonconformances to the SFSP were recorded during completion of the SI at the Sinkholes at Pelham Range.

3.10 Data Quality

The field sample analytical data are presented in tabular form in Appendix E. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 2001) and the stipulated requirements for the generation of definitive data presented in the SAP. Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms.

Data Validation. The reported analytical data were validated in accordance with EPA National Functional Guidelines by Level III criteria. The data validation results are summarized in a quality assurance report, which includes the data validation summary report (Appendix F). Selected results were rejected or otherwise qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC ShawView™ database for tracking and reporting. The qualified data were used in comparing to the SSSLs and ESVs. Rejected data (assigned an "R" qualifier) were not used in comparison to the SSSLs and ESVs. The data presented in this report, except where qualified, meet the principle data quality objective for this SI.

4.0 Site Characterization

This chapter provides information on regional and site-specific geology and hydrology for the Sinkholes at Pelham Range.

4.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county, and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province), where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992), and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984) but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated greenish-gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appear to dominate the unit and consist primarily of coarse-grained, vitreous quartzite, and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consist of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post as mapped by Warman and Causey (1962), and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. Weaver Cave, located approximately one mile west of the northwest boundary of the Main Post, is situated in gray dolomite and limestone mapped as the Rome Formation (Osborne et al., 1997). The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et. al., 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum

(Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone is comprised of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped as undifferentiated at FTMC and other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites and limestones, and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish-gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Osborne et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark to light gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale based on fossil data.

The Pennsylvanian Parkwood Formation overlies the Floyd Shale and consists of a medium to dark gray, silty, clay shale and mudstone with interbedded light to medium gray, very fine to fine grained, argillaceous, micaceous sandstone. Locally the Parkwood Formation also contains beds of medium- to dark-gray argillaceous, bioclastic to cherty limestone and beds of clayey coal up to a few inches thick (Raymond et. al., 1988). The Parkwood Formation in Calhoun County is generally found within a structurally complex area known as the Coosa deformed belt. In the deformed belt, the Parkwood Formation and Floyd Shale are mapped as undifferentiated because their lithologic similarity and significant deformation make it impractical to map the contact (Thomas and Drahovzal, 1974; Osborne et al., 1988). The undifferentiated Parkwood Formation and Floyd Shale are found throughout the western quarter of Pelham Range.

The Jacksonville thrust fault is the most significant structural geologic feature in the vicinity of the Main Post of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence that makes up the Eden thrust sheet is exposed at FTMC through an eroded window, or fenster, in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation, north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). Two small klippen of the Shady Dolomite, bounded by the Jacksonville fault, have been recognized adjacent to the Pell City fault at the FTMC window (Osborne et al., 1997).

The Pell City fault serves as a fault contact between the bedrock within the FTMC window and the Rome and Conasauga Formations. The trace of the Pell City fault is also exposed approximately nine miles west of the FTMC window on Pelham Range where it traverses northeast to southwest across the western quarter of Pelham Range. Here, the trace of the Pell City fault marks the boundary between the Pell City thrust sheet and the Coosa deformed belt.

The eastern three quarters of Pelham Range is located within the Pell City thrust sheet while the remaining western quarter of Pelham is located within the Coosa deformed belt. The Pell City thrust sheet is a large-scale thrust sheet containing Cambrian and Ordovician rocks and is relatively less structurally complex than the Coosa deformed belt (Thomas and Neathery, 1982). The Pell City thrust sheet is exposed between the traces of the Jacksonville and Pell City faults

along the western boundary of the FTMC window, and along the trace of the Pell City fault on Pelham Range (Thomas and Neathery, 1982; Osborne et al., 1988). The Coosa deformed belt is a narrow northeast-to-southwest-trending linear zone of complex structure (approximately 5 to 20 miles wide by approximately 90 miles in length) consisting mainly of thin imbricate thrust slices. The structure within these imbricate thrust slices is often internally complicated by small-scale folding and additional thrust faults (Thomas and Drahovzal, 1974).

4.2 Site Geology

The soil type mapped at Area 8C is the Lee silt loam. The Lee silt loam developed in local alluvium, commonly free of chert, occurs in sinks along small drainageways and at the head of small drainageways. This soil type is poorly drained, 0 to 2 percent slope, and is subject to frequent overflow or ponding. Soils encountered during hand auger sampling at Area 8C were primarily inorganic silts, silty sandy clays, clayey gravels, and gravelly clays.

The soil type mapped at Area 22C is the Clarksville-Fullerton stony loams. These soils are stony, deep to moderately deep, well-drained, with slopes of 0 to 10 percent. At Area 22C, soils encountered at PR-22C-SB01 were soft clays, brown with red mottling; gleyed soil was also encountered.

The Area 24C soil type is the Anniston and Allen gravelly loam. These soils are eroded, well-drained with slopes of 2 to 6 percent. At Area 24C, soils encountered were reddish brown to reddish orange, medium stiff to stiff clay with some silt.

The soil type mapped at Area 2D is the Decatur and Cumberland loam. These soils are deep and well-drained with slopes of 2 to 6 percent. At Area 2D, soils encountered were soft to medium stiff clays, brown to light gray to yellowish orange. Weathered quartz and sandstone gravel was encountered at 8 feet bgs.

Bedrock beneath the sinkholes collected at Area 8C and Area 22C is mapped as the Knox Group. The Newala Limestone is beneath the surface low at Area 24C and the Conasauga Formation is mapped beneath Area 2D. Bedrock was not encountered during hand augering activities at any of these Pelham Range locations.

4.3 Site Hydrology

Pelham Range is located within the Cane Creek Drainage Basin. Surface water runoff from Area 24C and Area 2D would flow south to southeast through tributaries emptying into Cane Creek.

Cane Creek flows in a westerly direction emptying into the Coosa River along the western boundary of Calhoun County. The sinkholes at Area 8C and Area 22C retain water during heavy precipitation.

5.0 Summary of Analytical Results

The results of the chemical analysis of samples collected at the Sinkholes at Pelham Range, indicate that metals, VOCs, pesticides, herbicides, and explosive compounds were detected in site media. SVOCs and PCBs were not detected in any of the samples collected. To evaluate whether the detected constituents present an unacceptable risk to human health and the environment, the analytical results were compared to the human health SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed for human health and ecological risk evaluations as part of investigations being performed under the BRAC Environmental Restoration Program at FTMC.

Metals concentrations exceeding the SSSLs and ESVs were subsequently compared to metals background screening values to determine if the metals concentrations are within natural background concentrations (SAIC, 1998). It should be noted that the SSSLs and ESVs are greater than background values in some instances.

The following sections and Tables 5-1 and 5-2 summarize the results of the comparison of detected constituents to the SSSLs, ESVs, and background screening values. Complete analytical results are presented in Appendix E.

5.1 Surface Soil Analytical Results

A total of seven surface soil samples were collected for chemical analysis. The samples were collected from the uppermost foot of soil at the locations shown on Figures 3-1 through 3-4. Analytical results were compared to residential human health SSSLs, ESVs, and metals background screening values as presented in Table 5-1.

5.1.1 Area 8C

Four surface soil samples were collected from the sinkhole located in Area 8C. Metals, VOCs, pesticides, explosives, and one herbicide were detected in the samples. SVOCs and PCBs were not detected in the samples.

Metals. A total of 18 metals were detected in the samples. The concentrations of four metals (aluminum, arsenic, iron, and manganese) exceeded SSSLs in one or more samples but were below their respective background values. The concentrations of seven metals (aluminum, chromium, iron, manganese, mercury, selenium, and vanadium) exceeded ESVs but were below their respective background values except for the following metals in one sample each:

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-22C-SB01					PR-24C-SB01				
Sample Number					XQ0013					XQ0021				
Sample Date					1-Aug-01					19-Jun-02				
Sample Depth (Feet)					0-1					0-1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
METALS														
Aluminum	mg/kg	1.63E+04	7.80E+03	5.00E+01	1.64E+04		YES	YES	YES	1.16E+04			YES	YES
Arsenic	mg/kg	1.37E+01	4.26E-01	1.00E+01	5.77E+00			YES		5.30E+00			YES	
Barium	mg/kg	1.24E+02	5.47E+02	1.65E+02	2.53E+02		YES		YES	5.95E+01				
Beryllium	mg/kg	8.00E-01	9.60E+00	1.10E+00	8.24E-01	J	YES			ND				
Calcium	mg/kg	1.72E+03	NA	NA	3.27E+02					7.46E+02				
Chromium	mg/kg	3.70E+01	2.32E+01	4.00E-01	1.60E+01				YES	1.38E+01				YES
Cobalt	mg/kg	1.52E+01	4.68E+02	2.00E+01	2.61E+00	J				1.69E+01		YES		
Copper	mg/kg	1.27E+01	3.13E+02	4.00E+01	3.93E+01		YES			1.05E+01				
Iron	mg/kg	3.42E+04	2.34E+03	2.00E+02	1.21E+04			YES	YES	1.29E+04			YES	YES
Lead	mg/kg	4.01E+01	4.00E+02	5.00E+01	4.04E+01		YES			8.38E+01		YES		YES
Magnesium	mg/kg	1.03E+03	NA	4.40E+05	4.56E+02					4.29E+02				
Manganese	mg/kg	1.58E+03	3.63E+02	1.00E+02	7.45E+01					9.48E+02			YES	YES
Mercury	mg/kg	8.00E-02	2.33E+00	1.00E-01	1.68E-01		YES		YES	5.18E-02	J			
Nickel	mg/kg	1.03E+01	1.54E+02	3.00E+01	1.06E+01		YES			1.04E+01		YES		
Potassium	mg/kg	8.00E+02	NA	NA	4.58E+02	J				5.57E+02	J			
Selenium	mg/kg	4.80E-01	3.91E+01	8.10E-01	ND					ND				
Sodium	mg/kg	6.34E+02	NA	NA	ND					6.02E+01	J			
Vanadium	mg/kg	5.88E+01	5.31E+01	2.00E+00	3.42E+01				YES	2.44E+01				YES
Zinc	mg/kg	4.06E+01	2.34E+03	5.00E+01	5.29E+01		YES		YES	4.11E+01		YES		
VOLATILE ORGANIC COMPOUNDS														
2-Butanone	mg/kg	NA	4.66E+03	8.96E+01	9.30E-03	J				2.20E-02	J			
Acetone	mg/kg	NA	7.76E+02	2.50E+00	1.50E-01	J				2.50E-01	J			
Methylene chloride	mg/kg	NA	8.41E+01	2.00E+00	ND					ND				
Styrene	mg/kg	NA	1.55E+03	1.00E-01	ND					ND				
Toluene	mg/kg	NA	1.55E+03	5.00E-02	2.50E-03	J				ND				
Trichlorofluoromethane	mg/kg	NA	2.33E+03	1.00E-01	ND					ND				
p-Cymene	mg/kg	NA	1.55E+03	NA	7.20E-03	J				ND				

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-22C-SB01					PR-24C-SB01				
Sample Number					XQ0013					XQ0021				
Sample Date					1-Aug-01					19-Jun-02				
Sample Depth (Feet)					0- 1					0- 1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
PESTICIDES														
4,4'-DDD	mg/kg	NA	2.54E+00	2.50E-03	ND					ND				
4,4'-DDT	mg/kg	NA	1.79E+00	2.50E-03	ND					2.90E-03	J			YES
Endosulfan II	mg/kg	NA	4.66E+01	1.19E-01	ND					ND				
Endosulfan sulfate	mg/kg	NA	4.66E+01	3.58E-02	ND					ND				
Endrin	mg/kg	NA	2.32E+00	1.00E-03	1.90E-03	J			YES	ND				
Endrin aldehyde	mg/kg	NA	2.32E-01	1.05E-02	2.40E-03	J				ND				
Heptachlor	mg/kg	NA	1.40E-01	1.00E-01	1.20E-03	J				ND				
alpha-BHC	mg/kg	NA	1.00E-01	2.50E-03	1.00E-02				YES	ND				
alpha-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	ND					ND				
beta-BHC	mg/kg	NA	3.50E-01	1.00E-03	1.00E-03	J			YES	7.60E-04	J			
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	5.00E-05	ND					4.90E-04	J			YES
gamma-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	2.70E-03	J				ND				
HERBICIDES														
2,4-D	mg/kg	NA	7.77E+01	1.00E-01	ND					ND				
EXPLOSIVES														
1,3,5-Trinitrobenzene	mg/kg	NA	2.32E+02	3.76E-01	ND					ND				
2,4-Dinitrotoluene	mg/kg	NA	9.27E-01	1.28E+00	ND					ND				
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	3.28E-02	ND					ND				
2-Nitrotoluene	mg/kg	NA	7.77E+01	NA	ND					ND				

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-2D-SB01					PR-8C-SB01					PR-8C-SB02				
Sample Number					XQ0017					XQ0001					XQ0004				
Sample Date					8-Nov-01					30-Jul-01					31-Jul-01				
Sample Depth (Feet)					0-1					0-1					0-1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
METALS																			
Aluminum	mg/kg	1.63E+04	7.80E+03	5.00E+01	1.99E+04		YES	YES	YES	1.15E+04			YES	YES	1.04E+04			YES	YES
Arsenic	mg/kg	1.37E+01	4.26E-01	1.00E+01	1.02E+01			YES	YES	5.65E+00			YES		2.39E+00			YES	
Barium	mg/kg	1.24E+02	5.47E+02	1.65E+02	6.18E+01					6.61E+01					1.09E+02				
Beryllium	mg/kg	8.00E-01	9.60E+00	1.10E+00	ND					2.80E-01	J				2.65E-01	J			
Calcium	mg/kg	1.72E+03	NA	NA	2.85E+02					1.21E+02	J				5.96E+02				
Chromium	mg/kg	3.70E+01	2.32E+01	4.00E-01	1.65E+01				YES	8.42E+00				YES	7.39E+00				YES
Cobalt	mg/kg	1.52E+01	4.68E+02	2.00E+01	4.09E+00					3.75E+00					4.12E+00				
Copper	mg/kg	1.27E+01	3.13E+02	4.00E+01	1.22E+01					8.54E+00					1.48E+01		YES		
Iron	mg/kg	3.42E+04	2.34E+03	2.00E+02	1.35E+04			YES	YES	6.97E+03			YES	YES	4.10E+03			YES	YES
Lead	mg/kg	4.01E+01	4.00E+02	5.00E+01	2.54E+01					1.18E+01					1.91E+01				
Magnesium	mg/kg	1.03E+03	NA	4.40E+05	7.91E+02					4.25E+02					4.72E+02				
Manganese	mg/kg	1.58E+03	3.63E+02	1.00E+02	1.17E+02				YES	1.05E+02				YES	1.43E+02				YES
Mercury	mg/kg	8.00E-02	2.33E+00	1.00E-01	7.00E-02	B				4.60E-02	J				8.70E-02	J	YES		
Nickel	mg/kg	1.03E+01	1.54E+02	3.00E+01	9.28E+00					6.07E+00					6.97E+00				
Potassium	mg/kg	8.00E+02	NA	NA	5.36E+02	J				2.37E+02	J				3.62E+02	J			
Selenium	mg/kg	4.80E-01	3.91E+01	8.10E-01	ND					6.49E-01	J	YES			1.05E+00	J	YES		YES
Sodium	mg/kg	6.34E+02	NA	NA	4.42E+01	J				ND					ND				
Vanadium	mg/kg	5.88E+01	5.31E+01	2.00E+00	3.34E+01				YES	1.77E+01				YES	1.07E+01				YES
Zinc	mg/kg	4.06E+01	2.34E+03	5.00E+01	5.83E+01		YES		YES	2.11E+01	J				2.41E+01	J			
VOLATILE ORGANIC COMPOUNDS																			
2-Butanone	mg/kg	NA	4.66E+03	8.96E+01	ND					4.50E-03	J				1.40E-02	J			
Acetone	mg/kg	NA	7.76E+02	2.50E+00	5.10E-01					9.70E-02	J				4.20E-01	J			
Methylene chloride	mg/kg	NA	8.41E+01	2.00E+00	5.00E-03	J				ND					ND				
Styrene	mg/kg	NA	1.55E+03	1.00E-01	ND					ND					5.40E-03	J			
Toluene	mg/kg	NA	1.55E+03	5.00E-02	3.30E-03	J				ND					9.40E-03	J			
Trichlorofluoromethane	mg/kg	NA	2.33E+03	1.00E-01	6.30E-03	J				ND					ND				
p-Cymene	mg/kg	NA	1.55E+03	NA	ND					2.40E-03	J				2.10E-02	J			

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-2D-SB01					PR-8C-SB01					PR-8C-SB02				
Sample Number					XQ0017					XQ0001					XQ0004				
Sample Date					8-Nov-01					30-Jul-01					31-Jul-01				
Sample Depth (Feet)					0- 1					0- 1					0- 1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
PESTICIDES																			
4,4'-DDD	mg/kg	NA	2.54E+00	2.50E-03	ND					ND					ND				
4,4'-DDT	mg/kg	NA	1.79E+00	2.50E-03	ND					3.20E-02				YES	ND				
Endosulfan II	mg/kg	NA	4.66E+01	1.19E-01	ND					ND					ND				
Endosulfan sulfate	mg/kg	NA	4.66E+01	3.58E-02	ND					ND					ND				
Endrin	mg/kg	NA	2.32E+00	1.00E-03	ND					ND					ND				
Endrin aldehyde	mg/kg	NA	2.32E-01	1.05E-02	ND					ND					ND				
Heptachlor	mg/kg	NA	1.40E-01	1.00E-01	ND					ND					8.10E-04	J			
alpha-BHC	mg/kg	NA	1.00E-01	2.50E-03	ND					1.30E-03	J				ND				
alpha-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	ND					ND					ND				
beta-BHC	mg/kg	NA	3.50E-01	1.00E-03	ND					ND					ND				
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	5.00E-05	ND					ND					ND				
gamma-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	ND					ND					ND				
HERBICIDES																			
2,4-D	mg/kg	NA	7.77E+01	1.00E-01	ND					4.70E-03	J				ND				
EXPLOSIVES																			
1,3,5-Trinitrobenzene	mg/kg	NA	2.32E+02	3.76E-01	ND					ND					ND				
2,4-Dinitrotoluene	mg/kg	NA	9.27E-01	1.28E+00	ND					2.80E-01	J				5.50E-01				
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	3.28E-02	ND					2.20E-01	J			YES	3.80E-01	J			YES
2-Nitrotoluene	mg/kg	NA	7.77E+01	NA	ND					ND					ND				

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-8C-SB03					PR-8C-SB04				
Sample Number					XQ0007					XQ0010				
Sample Date					31-Jul-01					31-Jul-01				
Sample Depth (Feet)					0-1					0-1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
METALS														
Aluminum	mg/kg	1.63E+04	7.80E+03	5.00E+01	6.18E+03				YES	5.97E+03				YES
Arsenic	mg/kg	1.37E+01	4.26E-01	1.00E+01	7.17E+00			YES		6.50E+00			YES	
Barium	mg/kg	1.24E+02	5.47E+02	1.65E+02	4.97E+01					6.61E+01				
Beryllium	mg/kg	8.00E-01	9.60E+00	1.10E+00	1.65E-01	J				1.88E-01	J			
Calcium	mg/kg	1.72E+03	NA	NA	3.96E+02					4.35E+02				
Chromium	mg/kg	3.70E+01	2.32E+01	4.00E-01	1.12E+01				YES	9.37E+00				YES
Cobalt	mg/kg	1.52E+01	4.68E+02	2.00E+01	2.52E+00	J				7.61E+00				
Copper	mg/kg	1.27E+01	3.13E+02	4.00E+01	1.04E+01					9.30E+00				
Iron	mg/kg	3.42E+04	2.34E+03	2.00E+02	8.08E+03			YES	YES	7.54E+03			YES	YES
Lead	mg/kg	4.01E+01	4.00E+02	5.00E+01	1.63E+01					1.31E+01				
Magnesium	mg/kg	1.03E+03	NA	4.40E+05	2.56E+02					2.21E+02				
Manganese	mg/kg	1.58E+03	3.63E+02	1.00E+02	2.10E+02				YES	5.67E+02			YES	YES
Mercury	mg/kg	8.00E-02	2.33E+00	1.00E-01	7.40E-02	J				1.52E-01		YES		YES
Nickel	mg/kg	1.03E+01	1.54E+02	3.00E+01	3.34E+00					3.45E+00				
Potassium	mg/kg	8.00E+02	NA	NA	2.40E+02	J				ND				
Selenium	mg/kg	4.80E-01	3.91E+01	8.10E-01	5.81E-01	J	YES			7.45E-01	J	YES		
Sodium	mg/kg	6.34E+02	NA	NA	ND					ND				
Vanadium	mg/kg	5.88E+01	5.31E+01	2.00E+00	2.76E+01				YES	1.73E+01				YES
Zinc	mg/kg	4.06E+01	2.34E+03	5.00E+01	1.79E+01	J				1.75E+01	J			
VOLATILE ORGANIC COMPOUNDS														
2-Butanone	mg/kg	NA	4.66E+03	8.96E+01	1.20E-02	J				2.10E-02	J			
Acetone	mg/kg	NA	7.76E+02	2.50E+00	3.20E-01	J				4.90E-01	J			
Methylene chloride	mg/kg	NA	8.41E+01	2.00E+00	ND					2.10E-03	J			
Styrene	mg/kg	NA	1.55E+03	1.00E-01	ND					ND				
Toluene	mg/kg	NA	1.55E+03	5.00E-02	2.10E-03	J				3.10E-03	J			
Trichlorofluoromethane	mg/kg	NA	2.33E+03	1.00E-01	ND					3.00E-03	J			
p-Cymene	mg/kg	NA	1.55E+03	NA	7.00E-03	J				4.40E-03	J			

Table 5-1

Surface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location					PR-8C-SB03					PR-8C-SB04				
Sample Number					XQ0007					XQ0010				
Sample Date					31-Jul-01					31-Jul-01				
Sample Depth (Feet)					0- 1					0- 1				
Parameter	Units	BKG[a]	SSSL[b]	ESV[b]	Result	Qual	>BKG	>SSSL	>ESV	Result	Qual	>BKG	>SSSL	>ESV
PESTICIDES														
4,4'-DDD	mg/kg	NA	2.54E+00	2.50E-03	ND					1.40E-03	J			
4,4'-DDT	mg/kg	NA	1.79E+00	2.50E-03	2.20E-03	J				1.10E-03	J			
Endosulfan II	mg/kg	NA	4.66E+01	1.19E-01	ND					2.10E-03	J			
Endosulfan sulfate	mg/kg	NA	4.66E+01	3.58E-02	ND					4.00E-03	J			
Endrin	mg/kg	NA	2.32E+00	1.00E-03	ND					3.90E-03	J			YES
Endrin aldehyde	mg/kg	NA	2.32E-01	1.05E-02	ND					ND				
Heptachlor	mg/kg	NA	1.40E-01	1.00E-01	ND					ND				
alpha-BHC	mg/kg	NA	1.00E-01	2.50E-03	2.10E-03	J				ND				
alpha-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	ND					2.10E-03	J			
beta-BHC	mg/kg	NA	3.50E-01	1.00E-03	ND					3.70E-03				YES
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	5.00E-05	ND					2.20E-03	J			YES
gamma-Chlordane	mg/kg	NA	1.69E+00	1.00E-01	ND					ND				
HERBICIDES														
2,4-D	mg/kg	NA	7.77E+01	1.00E-01	ND					ND				
EXPLOSIVES														
1,3,5-Trinitrobenzene	mg/kg	NA	2.32E+02	3.76E-01	ND					4.20E-01				YES
2,4-Dinitrotoluene	mg/kg	NA	9.27E-01	1.28E+00	ND					ND				
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	3.28E-02	ND					6.40E-01				YES
2-Nitrotoluene	mg/kg	NA	7.77E+01	NA	ND					3.50E+00				

Analyses performed using U.S. Environmental Protection Agency (EPA) SW-846 analytical methods.

[a] BKG - Background. Concentration listed is two times (2x) the arithmetic mean of background metals concentration given in SAIC, 1998, *Final Background Metals Survey Report, Fort McClellan, Alabama*, July.

[b] Residential human health site-specific screening level (SSSL) and ecological screening value (ESV) as given in IT, 2000, *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

B - Analyte detected in laboratory or field blank at concentration greater than the reporting limit.

J - Compound was positively identified; reported value is an estimated concentration.

mg/kg - Milligrams per kilogram.

NA - Not available.

ND - Not detected.

Qual - Data validation qualifier.

Table 5-2

Subsurface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location				PR-22C-SB01				PR-22C-SB01				PR-24C-SB01			
Sample Number				XQ0014				XQ0015				XQ0022			
Sample Date				1-Aug-01				1-Aug-01				19-Jun-02			
Sample Depth (Feet)				2 - 4				7 - 8				3 - 4			
Parameter	Units	BKG[a]	SSSL[b]	Result	Qual	>BKG	>SSSL	Result	Qual	>BKG	>SSSL	Result	Qual	>BKG	>SSSL
METALS															
Aluminum	mg/kg	1.36E+04	7.80E+03	1.24E+04			YES	4.80E+03				1.12E+04			YES
Arsenic	mg/kg	1.83E+01	4.26E-01	5.28E+00			YES	1.21E+00			YES	6.53E+00			YES
Barium	mg/kg	2.34E+02	5.47E+02	1.25E+02				4.36E+01				1.77E+01			
Beryllium	mg/kg	8.60E-01	9.60E+00	3.98E-01	J			1.67E-01	J			ND			
Calcium	mg/kg	6.37E+02	NA	4.89E+02				2.61E+02				2.41E+02			
Chromium	mg/kg	3.83E+01	2.32E+01	9.99E+00				6.16E+00				1.58E+01			
Cobalt	mg/kg	1.75E+01	4.68E+02	4.85E+00				5.65E-01	J			3.33E+00			
Copper	mg/kg	1.94E+01	3.13E+02	1.47E+01				6.10E+00				1.11E+01			
Iron	mg/kg	4.48E+04	2.34E+03	1.30E+04			YES	2.70E+03			YES	1.96E+04			YES
Lead	mg/kg	3.85E+01	4.00E+02	1.62E+01				7.14E+00				2.86E+01			
Magnesium	mg/kg	7.66E+02	NA	3.35E+02				1.80E+02				3.76E+02			
Manganese	mg/kg	1.36E+03	3.63E+02	4.14E+02			YES	1.27E+02				1.11E+02			
Mercury	mg/kg	7.00E-02	2.33E+00	6.80E-02	J			3.60E-02	J			6.57E-02	J		
Nickel	mg/kg	1.29E+01	1.54E+02	6.57E+00				1.66E+00	J			1.10E+01			
Potassium	mg/kg	7.11E+02	NA	3.44E+02	J			2.50E+02	J			6.69E+02			
Selenium	mg/kg	4.70E-01	3.91E+01	ND				ND				ND			
Sodium	mg/kg	7.02E+02	NA	ND				ND				ND			
Vanadium	mg/kg	6.49E+01	5.31E+01	2.31E+01				1.45E+01				3.35E+01			
Zinc	mg/kg	3.49E+01	2.34E+03	9.04E+01		YES		8.25E+00				5.06E+01		YES	
VOLATILE ORGANIC COMPOUNDS															
2-Butanone	mg/kg	NA	4.66E+03	7.50E-03	J			4.90E-03	J			ND			
4-Methyl-2-pentanone	mg/kg	NA	6.21E+02	ND				ND				ND			
Acetone	mg/kg	NA	7.76E+02	1.10E-01	J			2.90E-02	B			3.60E-02	J		
Methylene chloride	mg/kg	NA	8.41E+01	2.30E-03	B			ND				ND			
Trichlorofluoromethane	mg/kg	NA	2.33E+03	4.20E-03	J			ND				ND			
p-Cymene	mg/kg	NA	1.55E+03	ND				ND				ND			
PESTICIDES															
4,4'-DDT	mg/kg	NA	1.79E+00	ND				ND				1.30E-03	J		
Endosulfan sulfate	mg/kg	NA	4.66E+01	ND				ND				ND			
Endrin	mg/kg	NA	2.32E+00	ND				ND				ND			
Heptachlor	mg/kg	NA	1.40E-01	1.30E-03	J			1.20E-03	J			ND			
alpha-BHC	mg/kg	NA	1.00E-01	ND				ND				ND			
beta-BHC	mg/kg	NA	3.50E-01	1.00E-03	J			7.40E-04	J			8.40E-04	J		
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	ND				ND				ND			
EXPLOSIVES															
1,3-Dinitrobenzene	mg/kg	NA	7.76E-01	ND				ND				ND			
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	ND				ND				ND			

Table 5-2

Subsurface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location				PR-2D-SB01				PR-2D-SB01				PR-8C-SB01			
Sample Number				XQ0018				XQ0019				XQ0002			
Sample Date				8-Nov-01				8-Nov-01				30-Jul-01			
Sample Depth (Feet)				4 - 5				7 - 8				2 - 4			
Parameter	**Units**	**BKG[a]**	**SSSL[b]**	**Result**	**Qual**	**>BKG**	**>SSSL**	**Result**	**Qual**	**>BKG**	**>SSSL**	**Result**	**Qual**	**>BKG**	**>SSSL**
METALS															
Aluminum	mg/kg	1.36E+04	7.80E+03	3.60E+04		YES	YES	2.13E+04		YES	YES	1.02E+04			YES
Arsenic	mg/kg	1.83E+01	4.26E-01	4.39E+01		YES	YES	4.71E+01		YES	YES	6.06E+00			YES
Barium	mg/kg	2.34E+02	5.47E+02	2.47E+01				1.33E+01				7.83E+01			
Beryllium	mg/kg	8.60E-01	9.60E+00	ND				4.08E-01	J			2.98E-01	J		
Calcium	mg/kg	6.37E+02	NA	9.60E+01	J			9.15E+01	J			2.47E+02			
Chromium	mg/kg	3.83E+01	2.32E+01	2.70E+01			YES	2.20E+01				7.69E+00			
Cobalt	mg/kg	1.75E+01	4.68E+02	4.96E+00				4.09E+00				5.36E+00			
Copper	mg/kg	1.94E+01	3.13E+02	2.86E+01		YES		3.06E+01		YES		6.72E+00			
Iron	mg/kg	4.48E+04	2.34E+03	3.28E+04			YES	2.72E+04			YES	5.78E+03			YES
Lead	mg/kg	3.85E+01	4.00E+02	1.60E+01				1.56E+01				8.91E+00			
Magnesium	mg/kg	7.66E+02	NA	7.97E+02		YES		5.17E+02				3.78E+02			
Manganese	mg/kg	1.36E+03	3.63E+02	6.80E+01				7.76E+01				2.36E+02			
Mercury	mg/kg	7.00E-02	2.33E+00	5.10E-02	B			4.40E-02	B			3.20E-02			
Nickel	mg/kg	1.29E+01	1.54E+02	2.06E+01		YES		1.99E+01		YES		7.15E+00			
Potassium	mg/kg	7.11E+02	NA	8.30E+02		YES		6.81E+02				2.31E+02	J		
Selenium	mg/kg	4.70E-01	3.91E+01	ND				ND				ND			
Sodium	mg/kg	7.02E+02	NA	5.15E+01	J			3.79E+01	J			ND			
Vanadium	mg/kg	6.49E+01	5.31E+01	7.25E+01		YES	YES	6.38E+01			YES	1.56E+01			
Zinc	mg/kg	3.49E+01	2.34E+03	5.94E+01		YES		7.20E+01		YES		2.02E+01	J		
VOLATILE ORGANIC COMPOUNDS															
2-Butanone	mg/kg	NA	4.66E+03	ND				ND				ND			
4-Methyl-2-pentanone	mg/kg	NA	6.21E+02	1.10E-02	J			ND				ND			
Acetone	mg/kg	NA	7.76E+02	3.50E-02	J			1.70E-02	J			4.50E-02	B		
Methylene chloride	mg/kg	NA	8.41E+01	4.60E-03	J			4.60E-03	J			ND			
Trichlorofluoromethane	mg/kg	NA	2.33E+03	3.10E-03	J			5.70E-03	J			ND			
p-Cymene	mg/kg	NA	1.55E+03	ND				ND				ND			
PESTICIDES															
4,4'-DDT	mg/kg	NA	1.79E+00	1.10E-03	J			ND				3.20E-02			
Endosulfan sulfate	mg/kg	NA	4.66E+01	ND				ND				6.40E-03			
Endrin	mg/kg	NA	2.32E+00	ND				ND				ND			
Heptachlor	mg/kg	NA	1.40E-01	ND				ND				ND			
alpha-BHC	mg/kg	NA	1.00E-01	ND				ND				2.00E-03	J		
beta-BHC	mg/kg	NA	3.50E-01	ND				ND				ND			
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	ND				ND				6.70E-04	J		
EXPLOSIVES															
1,3-Dinitrobenzene	mg/kg	NA	7.76E-01	ND				ND				ND			
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	ND				ND				1.30E-01	J		

Table 5-2

Subsurface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location				PR-8C-SB01				PR-8C-SB02				PR-8C-SB02			
Sample Number				XQ0003				XQ0005				XQ0006			
Sample Date				30-Jul-01				31-Jul-01				31-Jul-01			
Sample Depth (Feet)				7 - 8				2 - 4				6 - 6.5			
Parameter	**Units**	**BKG[a]**	**SSSL[b]**	**Result**	**Qual**	**>BKG**	**>SSSL**	**Result**	**Qual**	**>BKG**	**>SSSL**	**Result**	**Qual**	**>BKG**	**>SSSL**
METALS															
Aluminum	mg/kg	1.36E+04	7.80E+03	6.03E+03				8.52E+03			YES	9.07E+03			YES
Arsenic	mg/kg	1.83E+01	4.26E-01	1.67E+00			YES	4.81E+00			YES	4.61E+00			YES
Barium	mg/kg	2.34E+02	5.47E+02	7.65E+01				4.29E+01				6.32E+01			
Beryllium	mg/kg	8.60E-01	9.60E+00	2.31E-01	J			2.27E-01	J			2.79E-01	J		
Calcium	mg/kg	6.37E+02	NA	4.18E+02				1.14E+02	J			2.16E+02			
Chromium	mg/kg	3.83E+01	2.32E+01	5.15E+00				6.15E+00				7.30E+00			
Cobalt	mg/kg	1.75E+01	4.68E+02	2.73E+00				5.02E+00				3.19E+00			
Copper	mg/kg	1.94E+01	3.13E+02	3.84E+00				4.97E+00				9.85E+00			
Iron	mg/kg	4.48E+04	2.34E+03	2.91E+03			YES	5.71E+03			YES	5.01E+03			YES
Lead	mg/kg	3.85E+01	4.00E+02	7.02E+00				9.40E+00				1.08E+01			
Magnesium	mg/kg	7.66E+02	NA	2.44E+02				2.97E+02				3.16E+02			
Manganese	mg/kg	1.36E+03	3.63E+02	2.58E+02				2.66E+02				1.09E+02			
Mercury	mg/kg	7.00E-02	2.33E+00	ND				3.60E-02	J			3.30E-02	J		
Nickel	mg/kg	1.29E+01	1.54E+02	3.03E+00				4.29E+00				4.91E+00			
Potassium	mg/kg	7.11E+02	NA	1.94E+02	J			1.77E+02	J			1.60E+02	J		
Selenium	mg/kg	4.70E-01	3.91E+01	ND				ND				5.26E-01	J	YES	
Sodium	mg/kg	7.02E+02	NA	ND				ND				ND			
Vanadium	mg/kg	6.49E+01	5.31E+01	8.44E+00				1.22E+01				1.30E+01			
Zinc	mg/kg	3.49E+01	2.34E+03	1.25E+01	J			1.39E+01	J			1.63E+01	J		
VOLATILE ORGANIC COMPOUNDS															
2-Butanone	mg/kg	NA	4.66E+03	ND				ND				ND			
4-Methyl-2-pentanone	mg/kg	NA	6.21E+02	ND				ND				ND			
Acetone	mg/kg	NA	7.76E+02	1.00E-02	B			7.40E-02	J			4.30E-02	J		
Methylene chloride	mg/kg	NA	8.41E+01	ND				ND				ND			
Trichlorofluoromethane	mg/kg	NA	2.33E+03	1.50E-03	J			ND				2.50E-03	J		
p-Cymene	mg/kg	NA	1.55E+03	ND				ND				ND			
PESTICIDES															
4,4'-DDT	mg/kg	NA	1.79E+00	ND				2.30E-03	J			3.10E-03	J		
Endosulfan sulfate	mg/kg	NA	4.66E+01	ND				ND				ND			
Endrin	mg/kg	NA	2.32E+00	ND				2.00E-03	J			2.00E-03	J		
Heptachlor	mg/kg	NA	1.40E-01	ND				ND				ND			
alpha-BHC	mg/kg	NA	1.00E-01	7.70E-04	J			5.10E-04	J			9.00E-04	J		
beta-BHC	mg/kg	NA	3.50E-01	ND				ND				ND			
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	ND				ND				ND			
EXPLOSIVES															
1,3-Dinitrobenzene	mg/kg	NA	7.76E-01	ND				ND				1.90E-01	J		
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	ND				ND				ND			

Table 5-2

Subsurface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Sample Location				PR-8C-SB04				PR-8C-SB04			
Sample Number				XQ0011				XQ0012			
Sample Date				31-Jul-01				31-Jul-01			
Sample Depth (Feet)				2 - 2.5				2.5 - 3			
Parameter	**Units**	**BKG[a]**	**SSSL[b]**	**Result**	**Qual**	**>BKG**	**>SSSL**	**Result**	**Qual**	**>BKG**	**>SSSL**
METALS											
Aluminum	mg/kg	1.36E+04	7.80E+03	1.46E+04		YES	YES	1.54E+04		YES	YES
Arsenic	mg/kg	1.83E+01	4.26E-01	3.56E+01		YES	YES	3.06E+01		YES	YES
Barium	mg/kg	2.34E+02	5.47E+02	2.85E+01				2.32E+01			
Beryllium	mg/kg	8.60E-01	9.60E+00	9.01E-02	J			8.32E-02	J		
Calcium	mg/kg	6.37E+02	NA	3.02E+02				2.23E+02			
Chromium	mg/kg	3.83E+01	2.32E+01	2.04E+01				1.65E+01			
Cobalt	mg/kg	1.75E+01	4.68E+02	2.18E+00	J			2.54E+00			
Copper	mg/kg	1.94E+01	3.13E+02	8.00E+00				1.07E+01			
Iron	mg/kg	4.48E+04	2.34E+03	3.11E+04			YES	2.96E+04			YES
Lead	mg/kg	3.85E+01	4.00E+02	8.16E+00				9.23E+00			
Magnesium	mg/kg	7.66E+02	NA	3.83E+02				3.91E+02			
Manganese	mg/kg	1.36E+03	3.63E+02	4.98E+01				7.58E+01			
Mercury	mg/kg	7.00E-02	2.33E+00	5.30E-02	J			4.90E-02	J		
Nickel	mg/kg	1.29E+01	1.54E+02	4.11E+00				5.13E+00			
Potassium	mg/kg	7.11E+02	NA	2.27E+02	J			3.15E+02	J		
Selenium	mg/kg	4.70E-01	3.91E+01	1.12E+00	J	YES		4.65E-01	J		
Sodium	mg/kg	7.02E+02	NA	ND				ND			
Vanadium	mg/kg	6.49E+01	5.31E+01	4.94E+01				4.76E+01			
Zinc	mg/kg	3.49E+01	2.34E+03	1.25E+01	J			1.44E+01	J		
VOLATILE ORGANIC COMPOUNDS											
2-Butanone	mg/kg	NA	4.66E+03	ND				ND			
4-Methyl-2-pentanone	mg/kg	NA	6.21E+02	ND				ND			
Acetone	mg/kg	NA	7.76E+02	2.90E-02	B			6.40E-02	J		
Methylene chloride	mg/kg	NA	8.41E+01	ND				1.70E-03	J		
Trichlorofluoromethane	mg/kg	NA	2.33E+03	1.30E-03	J			ND			
p-Cymene	mg/kg	NA	1.55E+03	ND				3.00E-03	J		
PESTICIDES											
4,4'-DDT	mg/kg	NA	1.79E+00	ND				ND			
Endosulfan sulfate	mg/kg	NA	4.66E+01	ND				ND			
Endrin	mg/kg	NA	2.32E+00	ND				ND			
Heptachlor	mg/kg	NA	1.40E-01	ND				ND			
alpha-BHC	mg/kg	NA	1.00E-01	ND				ND			
beta-BHC	mg/kg	NA	3.50E-01	ND				ND			
gamma-BHC (Lindane)	mg/kg	NA	4.85E-01	ND				ND			
EXPLOSIVES											
1,3-Dinitrobenzene	mg/kg	NA	7.76E-01	ND				ND			
2,6-Dinitrotoluene	mg/kg	NA	9.27E-01	ND				ND			

Table 5-2

Subsurface Soil Analytical Results
Sinkholes at Pelham Range
Fort McClellan, Calhoun County, Alabama

Analyses performed using U.S. Environmental Protection Agency (EPA) SW-846 analytical methods.

[a] BKG - Background. Concentration listed is two times (2x) the arithmetic mean of background metals concentration given in SAIC, 1998, *Final Background Metals Survey Report, Fort McClellan, Alabama*, July.

[b] Residential human health site-specific screening level (SSSL) as given in IT Corporation (2000), *Final Human Health and Ecological Screening Values and PAH Background Summary Report, Fort McClellan, Calhoun County, Alabama*, July.

B - Analyte detected in laboratory or field blank at concentration greater than the reporting limit.

J - Compound was positively identified; reported value is an estimated concentration.

mg/kg - Milligrams per kilogram.

NA - Not available.

ND - Not detected.

Qual - Data validation qualifier.

- Mercury (0.15 milligrams per kilogram [mg/kg]) exceeded its ESV (0.1 mg/kg) and background (0.08 mg/kg) at sample location PR-8C-SB04.

- Selenium (1.05 mg/kg) exceeded its ESV (0.81 mg/kg) and background (0.48 mg/kg) at sample location PR-8C-SB02. The selenium result was flagged with a "J" data qualifier, indicating that the concentration was estimated.

VOCs. A total of seven VOCs (2-butanone, acetone, methylene chloride, p-cymene, styrene, toluene, and trichlorofluoromethane) were detected at estimated concentrations in the samples. VOC concentrations ranged from 0.0021 to 0.49 mg/kg and all results were below SSSLs and ESVs.

Pesticides. A total of 10 pesticides were detected in the samples: 4,4'-DDD, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, endosulfan II, endosulfan sulfate, endrin, gamma-BHC, and heptachlor. All but two of the results were flagged with a "J" data qualifier, indicating that the concentrations were estimated. Pesticide concentrations ranged from 0.00081 to 0.032 mg/kg and all results were below SSSLs. The concentrations of four compounds exceeded their respective ESVs in one sample each:

- 4,4'-DDT (0.032 mg/kg) exceeded its ESV (0.0025 mg/kg) at sample location PR-8C-SB01.

- Beta-BHC (0.0037 mg/kg) exceeded its ESV (0.001 mg/kg) at sample location PR-8C-SB04.

- Endrin (0.0039 mg/kg) exceeded its ESV (0.001 mg/kg) at sample location PR-8C-SB04.

- Gamma-BHC (0.0022 mg/kg) exceeded its ESV (0.00005 mg/kg) at sample location PR-8C-SB04.

Herbicides. One herbicide (2,4-D) was detected in one sample (location PR-8C-SB01) at an estimated concentration (0.0047 mg/kg) below its SSSL and ESV.

Explosives. A total of four explosive compounds were detected in the samples: 1,3,5-trinitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and 2-nitrotoluene. Explosive concentrations ranged from 0.22 to 3.5 mg/kg and all results were below SSSLs. The concentrations of two compounds exceeded their respective ESVs:

- 1,3,5-Trinitrobenzene (0.42 mg/kg) exceeded its ESV (0.38 mg/kg) at sample location PR-8C-SB04.

- 2,6-Dinitrotoluene (0.22 to 0.64 mg/kg) exceeded its ESV (0.03 mg/kg) at three sample locations (PR-8C-SB01, PR-8C-SB02, and PR-8C-SB04).

5.1.2 Area 22C

One surface soil sample was collected from the sinkhole located in Area 22C. Metals, VOCs, and pesticides were detected in the sample. SVOCs, herbicides, explosives, and PCBs were not detected in the sample.

Metals. Seventeen metals were detected in the sample. The concentrations of three metals (aluminum, arsenic, and iron) exceeded SSSLs but were below their respective background values except for aluminum. The concentrations of seven metals (aluminum, barium, chromium, iron, mercury, vanadium, and zinc) exceeded ESVs. Of these, aluminum, barium, mercury, and zinc also exceeded their respective background values.

VOCs. Four VOCs (2-butanone, acetone, p-cymene, and toluene) were detected in the sample at estimated concentrations ranging from 0.0025 to 0.15 mg/kg. All results were below SSSLs and ESVs.

Pesticides. Six pesticides were detected in the sample: alpha-BHC, beta-BHC, endrin, endrin aldehyde, gamma-chlordane, and heptachlor. All but one of the pesticide results were flagged with a "J" data qualifier, indicating that the concentrations were estimated. Pesticide concentrations ranged from 0.001 to 0.01 mg/kg and all results were below SSSLs. The concentrations of two compounds exceeded their respective ESVs:

- Alpha-BHC (0.01 mg/kg) exceeded its ESV (0.0025 mg/kg).
- Endrin (0.0019 mg/kg) exceeded its ESV (0.001 mg/kg).

5.1.3 Area 24C

One surface soil sample was collected from the depression located in Area 24C. Metals, VOCs, and pesticides were detected in the sample. SVOCs, herbicides, explosives, and PCBs were not detected in the sample.

Metals. Seventeen metals were detected in the sample. The concentrations of four metals (aluminum, arsenic, iron, and manganese) exceeded SSSLs but were below their respective background values. The concentrations of six metals (aluminum, chromium, iron, lead,

manganese, and vanadium) exceeded ESVs. Of these, only lead (83.8 mg/kg) also exceeded its background value (40 mg/kg).

VOCs. Two VOCs (2-butanone and acetone) were detected in the sample at estimated concentrations (0.022 and 0.25 mg/kg) below SSSLs and ESVs.

Pesticides. Three pesticides (4,4'-DDT, beta-BHC, and gamma-BHC) were detected in the sample at estimated concentrations. Pesticide concentrations ranged from 0.00049 to 0.0029 mg/kg and all results were below SSSLs. The concentrations of two compounds exceeded ESVs:

- 4,4'-DDT (0.0029 mg/kg) exceeded its ESV (0.0025 mg/kg).
- Gamma-BHC (0.00049 mg/kg) exceeded its ESV (0.00005 mg/kg).

5.1.4 Area 2D

One surface soil sample was collected from the surface depression located in Area 2D. Metals and VOCs were the only detected constituents in the sample. SVOCs, pesticides, herbicides, explosives, and PCBs were not detected in the sample.

Metals. Seventeen metals were detected in the sample. The concentrations of three metals (aluminum, arsenic, and iron) exceeded SSSLs but were below their respective background values except for aluminum. The concentrations of seven metals (aluminum, arsenic, chromium, iron, manganese, vanadium, and zinc) exceeded ESVs. Of these, only aluminum and zinc also exceeded their respective background values.

VOCs. Four VOCs (acetone, methylene chloride, toluene, and trichlorofluoromethane) were detected at concentrations (0.0033 to 0.51 mg/kg) below SSSLs and ESVs.

5.2 Subsurface Soil Analytical Results

A total of 11 subsurface soil samples were collected from seven borings for chemical analysis. Subsurface soil samples were collected at depths ranging from 2 to 8 feet bgs at the locations shown on Figures 3-1 through 3-4. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-2.

5.2.1 Area 8C

A total of six subsurface soil samples were collected from three soil borings at the Area 8C sinkhole. Metals, VOCs, pesticides, and explosives were detected in the samples. SVOCs, herbicides, and PCBs were not detected in the samples.

Metals. A total of 18 metals were detected in the samples. The concentrations of three metals (aluminum, arsenic, and iron) exceeded SSSLs but were below their respective background values except for aluminum and arsenic in two samples each from location PR-8C-SB04. The sample depths were 2 to 2.5 feet bgs and 2.5 to 3 feet bgs.

VOCs. A total of four VOCs (acetone, methylene chloride, p-cymene, and trichlorofluoromethane) were detected in the samples. VOC concentrations ranged from 0.0013 to 0.074 mg/kg and all results were below SSSLs.

Pesticides. A total of five pesticides were detected in the samples: 4,4'-DDT, alpha-BHC, endosulfan sulfate, endrin, and gamma-BHC. All but two of the pesticide results were flagged with a "J" data qualifier, indicating that the concentrations were estimated. Pesticide concentrations ranged from 0.00051 to 0.032 mg/kg and all results were below SSSLs.

Explosives. Two explosive compounds (2,6-dinitrotoluene and 1,3-dinitrobenzene) were detected at estimated concentrations in one sample each. Explosive concentrations were 0.13 and 0.19 mg/kg and were below SSSLs.

5.2.2 Area 22C

Two subsurface soil samples were collected from one soil boring at the Area 22C sinkhole. Metals, VOCs, and pesticides were detected in the samples. SVOCs, herbicides, explosives, and PCBs were not detected in the samples.

Metals. A total of 17 metals were detected in the samples. The concentrations of three metals (aluminum, arsenic, and iron) exceeded SSSLs but were below their respective background values.

VOCs. A total of four VOCs (2-butanone, acetone, methylene chloride, and trichlorofluoromethane) were detected in the samples. VOC concentrations ranged from 0.0023 to 0.11 mg/kg and all results were below SSSLs.

Pesticides. Two pesticides (beta-BHC and heptachlor) were detected at estimated concentrations in each of the samples. Pesticide concentrations ranged from 0.00074 to 0.0013 mg/kg and all results were below SSSLs.

5.2.3 Area 24C

One subsurface soil sample was collected from one soil boring at the Area 24C depression. Metals, pesticides, and one VOC were detected in the sample. SVOCs, herbicides, explosives, and PCBs were not detected in the sample.

Metals. Sixteen metals were detected in the sample. The concentrations of three metals (aluminum, arsenic, and iron) exceeded SSSLs but were below their respective background values.

VOCs. Acetone was detected in the sample at an estimated concentration (0.036 mg/kg) below its SSSL.

Pesticides. Two pesticides (4,4'-DDT and beta-BHC) were detected in the sample at estimated concentrations (0.0013 and 0.00084 mg/kg) below their respective SSSLs.

5.2.4 Area 2D

Two subsurface soil samples were collected from one soil boring at the Area 2D depression. The samples were collected at depths of 4 to 5 feet bgs and 7 to 8 feet bgs. Metals, VOCs, and one pesticide were detected in the samples. SVOCs, herbicides, explosives, and PCBs were not detected in the samples.

Metals. A total of 18 metals were detected in the samples. The concentrations of five metals (aluminum, arsenic, chromium, iron, and vanadium) exceeded SSSLs. Of these, aluminum (in both samples), arsenic (both samples), and vanadium (one sample, 4- to 5-foot sample depth) also exceeded their respective background values.

VOCs. A total of four VOCs (4-methyl-2-pentanone, acetone, methylene chloride, and trichlorofluoromethane) were detected at estimated concentrations in the samples. VOC concentrations ranged from 0.0031 to 0.035 mg/kg and all results were below SSSLs.

Pesticides. One pesticide (4,4'-DDT) was detected in one sample at an estimated concentration (0.0011 mg/kg) below its SSSL.

5.3 Statistical and Geochemical Evaluation of Site Metals Data

Site metals data were further evaluated using statistical and geochemical methods to determine if the metals detected in site media are site related. This multi-tiered approach is described in the Shaw technical memorandum "Selecting Site-Related Chemicals for Human Health and Ecological Risk Assessments for FTMC: Revision 2" (Shaw, 2003). The statistical and geochemical evaluation determined that the metals detected in site media are all naturally occurring (Appendix G).

6.0 Summary, Conclusions, and Recommendations

Shaw completed an SI at the Sinkholes at Pelham Range, at FTMC in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site as a result of historical mission-related Army activities. The SI consisted of three geophysical surveys and the collection and analysis of 7 surface soil samples and 11 subsurface soil samples. In addition, a field radiological survey was performed at the Area 24C location. This investigation was performed to fulfill the requirements of the MOA between the ALARNG and the U.S. Army with regard to the transfer of Pelham Range to the ALARNG. Although a preliminary assessment conducted by CHPPM identified these areas as "sinkholes," subsequent site reconnaissance revealed that one, and possibly two, of the sites are actually surface depressions or topographical low areas. Only the Area 8C and Area 22C locations have natural sinkhole characteristics. The Area 24C and Area 2D locations appear to be surface depressions or topographical low areas. Additionally, the Area 2D location may have been excavated in the past.

The geophysical surveys performed at the sinkholes and surface depressions in Areas 8C, 22C, and 24C did not indicate evidence of buried metal debris at these sites. The radiological survey conducted at the Area 24C low area did not indicate readings above background levels.

Chemical analysis of samples collected indicates that metals, VOCs, pesticides, explosive compounds, and one herbicide were detected in site media. SVOCs and PCBs were not detected in any of the samples collected. Analytical results were compared to the SSSLs, ESVs, and background screening values developed for human health and ecological risk evaluations as part of investigations performed under the BRAC Environmental Restoration Program at FTMC. Site metals data were also evaluated using statistical and geochemical methods to select site-related metals.

Although Pelham Range is projected for continued military training reuse by the ALARNG, residential SSSLs were used to screen these sites for risk assessment purposes. Constituents detected at concentrations exceeding SSSLs and background (where available) were identified as chemicals of potential concern (COPC) in site media. The only surface soil COPC identified was aluminum at Areas 22C and 2D. Subsurface soil COPCs were aluminum and arsenic at Areas 8C and 2D, and vanadium at Area 2D. However, the statistical and geochemical evaluation determined that these metals are present at naturally occurring levels. Therefore,

these metals are not expected to pose a threat to human health. VOC, pesticide, herbicide, and explosive compound concentrations in site media were all below SSSLs.

Constituents detected at concentrations exceeding ESVs and background (where available) were identified as constituents of potential ecological concern (COPEC) in surface soil. Metals, pesticides, and explosives were identified as discussed below.

Area 8C. COPECs identified at Area 8C were four pesticides (4,4'-DDT, beta-BHC, endrin, and gamma-BHC), two explosive compounds (2,6-dinitrotoluene and 1,3,5-trinitrobenzene), and two metals (mercury and selenium).

Area 22C. COPECs identified at Area 22C were two pesticides (alpha-BHC and endrin) and four metals (aluminum, barium, mercury, and zinc).

Area 24C. COPECs identified at Area 24C were two pesticides (4,4'-DDT and gamma-BHC) and one metal (lead).

Area 2D. COPECs identified at Area 2D were two metals (aluminum and zinc).

All of the metals COPECs were determined to be present at naturally occurring levels and, thus, do not pose a site-related risk to ecological receptors. The pesticides and explosives were generally detected at low estimated levels that only marginally exceeded their respective ESVs in most instances. The ESVs are highly conservative values, based on either no-observed-adverse-effects levels or the most health-protective values available, and are intended to be protective of the most sensitive individual organism. Therefore, risks to potential ecological receptors are likely overestimated. Based on these considerations, further investigation of the low levels of these contaminants is not warranted.

Based on the results of the SI, past operations at the Sinkholes at Pelham Range have not adversely impacted the environment. The metals and chemical compounds detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, Shaw recommends "No Further Action" and unrestricted land reuse with regard to CERCLA-related hazardous substances at the Sinkholes at Pelham Range.

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